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Tangcalagan DA, Daga CM, Tan A, Reyes RA, Macalinao MLM, Mationg ML, et al. The 2013-2015 Nationwide Prevalence Survey of Soil-Transmitted Helminths (STH) and Schistosomiasis among School-Age Children in Public Schools in the Philippines
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ORIGINAL ARTICLE

THE 2013-2015 NATIONWIDE PREVALENCE SURVEY OF SOIL-TRANSMITTED HELMINTHS (STH) AND SCHISTOSOMIASIS AMONG SCHOOL-AGE CHILDREN IN PUBLIC SCHOOLS IN THE PHILIPPINES

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ABSTRACT

Objectives: The Department of Health (DOH) aims to reduce the prevalence of intestinal parasitism and proportion of heavy intensity of infection in the country by 2022. Among the interventions is school-based mass drug administration (MDA). Regular assessment of MDA gives guidance to the DOH. The aim of this survey was to determine the prevalence of soil transmitted helminthiasis and schistosomiasis among public school children ages 5 to 16 years old.

Methodology: A cross-sectional, school-based study using multi-stage stratified cluster sampling was conducted from 2013 to 2015, covering the National Capital Region (NCR), and all provinces, except Maguindanao and Sulu. Stool samples were examined using the duplicate Kato Katz (KK).

Results: Of the 26,171 school children with stool samples examined, 7,440 (28.4%) were infected with at least one soil-transmitted helminth (STH). Infections among male students were significantly higher than female students (31.0% versus 26.0%). Heavy, moderate, and light intensity of infections were 3.2%, 29.0% and 67.7%, respectively. STH cumulative prevalence per province ranged between 0.5% and 89.5%. Schistosomiasis infections were detected in known non-endemic provinces: Ilocos Norte, Biliran, Tawi-Tawi, Basilan, and Dinagat Islands. Majority (68%) of the infections were with single parasites but as many as five parasites were detected in one child. Infections with heterophyids were also observed.

Conclusion: While the national prevalence of schistosomiasis was less than 1.0%, the cumulative prevalence of soil-transmitted helminthiasis among school-aged children was higher than the global figure of 24.0%.

KEYWORDS: *Soil-transmitted Helminthiasis, Schistosomiasis, School-aged Children, Prevalence, Intensity of Infections, Philippines*

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INTRODUCTION

Parasitic infections, particularly soil transmitted helminthiasis (STH) and schistosomiasis are among the most important public health problems around the world and both are recognized as Neglected Tropical Diseases (NTD).[1,2] The transmission of these infections is enhanced by poor living conditions, including inadequate sanitary facilities, improper human waste disposal, insufficient or unreliable water supply, poor knowledge of hygienic practices and substandard dwelling conditions.[3,4] Previous studies have shown high cumulative prevalence of STH infection ranging from 33.2% to 67.4%.[5-7] A 2008 study revealed 54% (1,820/3,373) of students were positive for any STH infection with 23.1% heavy-intensity infection.[8] *Schistosomiasis japonicum* causes serious, long term health problems and even death if left untreated. A schistosomiasis focal survey by the Department of Health in 2017 reported a national prevalence of 4.68%.[9]

The primary intervention of DOH to control the transmission and reduce the morbidity of these infections is administering preventive chemotherapy with albendazole for STH and praziquantel for schistosomiasis. In 2007, the Department of Health-Integrated Helminth Control Program (DOH-IHCP) started the nationwide mass deworming program (mass drug administration or MDA) in collaboration with the Department of Education (DepEd). The program covers school children ages 6-12 in all public elementary schools. A biannual deworming happens every January and July, with the purpose of reducing the prevalence to less than 30% after 3 years.[10] To monitor the impact of MDA, the World Health Organization (WHO) recommends surveys every 3-5 years. The data gathered could guide program implementers in prioritizing strategic actions to reach its objective of reducing the morbidity and mortality of STH infections, as well as *Schistosoma japonicum* infections.[11,12]

In 2013, the Department of Health Infectious Disease Office (DOH-IDO) commissioned the Research Institute for Tropical Medicine (RITM) to carry out a nationwide parasite survey. This study aimed to assess the current burden of soil transmitted helminths infections in every province by determining the prevalence and the intensity of parasitic infection among public school children ages 5-16 years old and to update the prevalence and burden of infection of *Schistosoma japonicum* in schistosoma-endemic areas.

METHODOLOGY

Sampling design

A multi-stage, cluster sampling design was applied. The 84 provinces (each of the four districts of the National Capital Region (NCR) was counted as a province) were classified as either schistosomiasis endemic (SE) or non-schistosomiasis endemic (non-SE) based on historical data provided by the DOH's Schistosomiasis Control and Elimination Program where primary and secondary public schools were selected (see Table 1). In the SE provinces, we purposely selected schools in barangays that reported schistosomiasis. Where there was more than one schistosomiasis endemic barangay, random selection was done among those barangays with the probability of selection proportional to the size of the number of students in a class. This approach was also used in the selection of schools and grade levels in non-SE provinces.

Table 1. List of the known 28 schistosomiasis endemic provinces

Agusan del Norte	Misamis Oriental
Agusan del Sur	Negros Occidental
Bohol	Northern Samar
Bukidnon	North Cotabato
Cagayan	Oriental Mindoro
Compostela Valley	Sorsogon
Davao del Norte	South Cotabato
Davao Oriental	Sultan Kudarat
Davao del Sur	Surigao del Norte
Eastern Samar	Surigao del Sur
Lanao del Norte	Western Samar
Lanao del Sur	Zamboanga del Norte
Leyte	Zamboanga del Sur
Maguindanao	Zamboanga Sibugay

To assess prevalence and intensity of STH and schistosomiasis infections, the WHO recommends examining 200-250 individuals from each ecologically homogeneous area.[13] Because the schistosomiasis prevalence is much lower than STH, sample size requirements for school children surveyed in SE provinces were arbitrarily doubled to increase probability of finding schistosomiasis cases. Thus, 250 school children from each of NSE provinces and 500 school children from each SE were targeted. Adjusting for an expected compliance rate of 70% for submitting stool samples, 36,000 students were targeted for enrolment to ensure the sample size of 28,000 will be reached.[14] To ensure students from the desired age groups were included, classes or sections from kindergarten to Grade 10 were regarded as sampling clusters. In each province, three class sections were selected from Grade 3, and one class section each from kindergarten to Grade 2 and Grade 4 to Grade 10, respectively.

Included in the study were students of either sex, aged 5 to 16 years, who had not taken any antihelminthic three months prior to stool collection, had a signed written parental consent, and had a signed written assent for children between 12-16 years. Students who had acute illnesses and those who could not provide suitable stool samples were excluded.

Organizing the Survey

Meetings were held between officials from the DOH-Infectious Disease Office (DOH-IDO) and Department of Education-Bureau of Learner Support Services (DepED-BLSS) to discuss the survey objectives and design and the logistic and operational support needed. The DOH-IDO endorsed the study to its regional offices and to the local government units (LGUs) through a Department Memorandum. A training of trainers was rolled out where teams from the DepED and DOH regional offices and their respective divisions at the provincial level were oriented on the objectives and procedures of the survey.

Medical technologists hired on a fulltime basis underwent intensive training in Kato Katz procedure. Those who failed to reach the required proficiency level of 100% underwent re-training until they passed the assessment.

Conducting the Survey

Parent-teacher association (PTA) meetings were held in each of the selected schools where trained teachers and school nurses oriented the parents or guardians and students on the nature and purpose of the study. Depending on their availability, either the district nurse or teacher obtained the written informed consent and assent from parents and students, respectively. At the school and during a pre-set schedule, pilot-tested data collection forms were used by the trained DepEd nurses and teachers to collect the following information: student's name, date of birth, age, sex, and the date of the last intake of deworming drug. Data were verified for completeness before the distribution of the stool collection kit to the students. Forms were sent to the designated laboratory in each province by the Barangay Health Workers (BHW) on the agreed date of specimen collection. Stool collection kits were provided to students who were trained on the proper stool collection, transport, labelling, and disposal of wastes. The students collected single stool samples at home and submitted them to the school nurse prior to the start of their classes. Students were given 4 days to submit their stool samples. All samples collected for the day were transported to the designated laboratory for processing and examination.

Processing and Examination of Stools

Duplicate smears were prepared using the 41.7mg Kato-Katz template for each sample. In a systematic manner, smears were examined using a compound light microscope within 24 hours.

The egg per gram for each species of STH was calculated by multiplying the egg count results to a constant factor (24) to classify the intensity of infections according to the WHO Guidelines. Results were recorded in a microscopy worksheet and transcribed in the individual case record form.

Ten percent of the total slides prepared were randomly selected each day for re-examination in a blinded manner by the validator microscopist. During the first two years, slides selected for quality control were sent by courier to RITM. However, by the third year of the survey, the selected slides were examined by the validator within 24 hours after the first reading.

Data Management and Analysis

Case report forms were completed, and data verified prior to double encoding in a data entry system developed using Microsoft Access 2013. Students with missing information (e.g., age and gender) were not included in the analysis. Students who were either below 5 years old or above 16 years old were excluded from the analysis due to their age being outside the recommended age for primary or secondary school. Statistical analyses were performed using Stata Version 13. Analysis of the data was according to age group (5-7 years, 8-9 years, 10-12 years and 13-16 years) and not on the grade level as indicated in the sampling design. The consideration was that there were children not within the assumed age-group of a specific grade level (e.g., a 10 year-old child in kindergarten). Parasitological parameters obtained were cumulative prevalence and intensity of STH infections. Intensities of infections with each STH species were reported in eggs per gram (EPG) and classified as light, moderate, or heavy according to the WHO classification by species (see Table 2). In addition, geometric mean egg counts (GMEC) were also computed for each helminth species.

The intensity of infection for the cumulative prevalence of STH was defined as follows: heavy-intensity infection: infected with at least one parasite at high intensity and all other parasite present at moderate or light intensity; moderate intensity infection: infected with at least one parasite at moderate-intensity and all other parasite species present at moderate or light intensity; light intensity infection: all parasite species present at light intensity.

Table 2. Thresholds of intensity of infection by STH species (geometric mean egg count, or GMEC, per gram of stool as examined by Kato-Katz method)

Species	Light	Moderate	Heavy
A. lumbricoides	1 - 4,999	5, 000 - 49,999	≥ 50,000
T. trichiura	1 - 999	1,000 - 9,999	≥ 10,000
Hookworm	1 - 1,999	2,000 - 3,999	≥ 4,000

The cumulative prevalence and species-specific prevalence were expressed in percentages. The cumulative prevalence was computed as the total number of children found positive for any of the STH parasite species divided by the total number of children examined and multiplied by 100. Computation for the species-specific prevalence was computed from the total number of students infected with specific species of STH and *S. japonicum* divided by the total number of children examined and multiplied by 100. The intensity of infection is expressed in eggs per gram of feces (EPG) and was computed[15] as follows:

Eggs per gram (EPG) feces = 1 egg X 24

Mean EPG was calculated as a geometric mean. Chi-square test was performed to determine the association of age group and sex with prevalence with the level of significance set at 0.05.

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Ethics Committee Approval

The study was granted approval by the RITM Institutional Review Board with approval number 2013-26. Written parental/guardian consent was obtained for all students. Written assent was also obtained from children 12 to 16 years old. Following information in the participant information sheet, the results of the stool examination were submitted to the school nurse for proper management. Parents and children were not directly informed of the results. Participant identification was limited to authorized research staff. The school nurses were provided a list of children who required treatment of their intestinal parasitic infections.

The Department of Health funded the survey. All authors declare no conflict of interest.

RESULTS

The prevalence survey was conducted from 2013-2015 in 82 of the 84 provinces in the country. Due to security concerns and logistical issues, the provinces of Sulu and Maguindanao were not surveyed. A total of 44,877 students were listed from randomly selected class levels of the 27/28 SE provinces (21,095 students), 55/56 non-SE provinces (23,782 students) including the 4 districts of the National Capital Region (NCR). Of the students that were selected, 27,352 (62.0%) students gave their assent to participate and, thus, were enrolled. However, only 58.3% (26,171) had the written consent of their parents. This is shown in Figure 1.

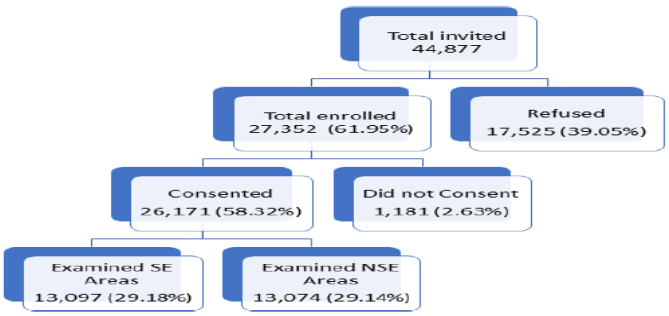

Figure 1. Breakdown of students invited to participate, number enrolled, number with parental consent and number who were from schistosomiasis endemic and non-endemic provinces

There was an equal proportion of students from SE provinces (29.2%) and non-SE provinces (29.1%). Almost half of the students were male (49.6%); as expected because of the sampling procedures, half were 8-9 years old. Table 3 illustrates the distribution by sex and age groups among schistosomiasis and non-schistosomiasis endemic provinces.

Table 3. Enrolled students by non-schistosomiasis endemic (NSE) and schistosomiasis-endemic (SE) provinces

Province Classification	Sex			Age Group			
	Male (%)	Female (%)	TOTAL	5-7 (%)	8-9 (%)	10-16 (%)	Total
NSE	6,312 (49.1)	6,533 (50.9)	12,845	3,342 (25.6)	6,811 (52.2)	2,888 (22.1)	13,041
SE	6,673 (50.1)	6,653 (49.9)	13,326	2,409 (18.4)	5,989 (45.9)	4,662 (35.7)	13, 060
TOTAL	12,985 (49.6)	13,186 (50.4)	26,171	5,751 (22.0)	12,800 (49.0)	7,550 (28.9)	26,101*

*Discrepancy in total number due to missing data on age.

Most provinces did not achieve the targeted sample size for that province; however, after computing for this study's power, not achieving the required sample size had no significant effect (see Supplementary Table 1). Although the sample size was computed according to whether a province was endemic for schistosomiasis or not, the cumulative prevalence and STH species prevalence are not presented following these categories.

STH Cumulative Prevalence and Range of Prevalence by Species

Overall, 28.4% (n=7,440) of students were infected with any of the three soil transmitted helminths: *Ascaris lumbricoides*, *Trichuris trichiura,* and hookworm. Infections were predominantly of light intensity (67.7%), followed by moderate (29.0%) and heavy (3.2%) intensities. The STH cumulative prevalence ranged from 0.5% (Ilocos Norte) to 89.5% (Sorsogon). Only one of the 279 students examined in Ilocos Norte had an intestinal parasite (*T. trichiura*).

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The most common STH parasite detected was *T. trichiura* (19.7%, n=5,159) followed by *A. lumbricoides* (17.4%; n=4,560); and hookworm (0.55%, n=144). The prevalence of *T. trichiura* was greater than that of *A. lumbricoides* in 60% of the provinces and ranged from 0.5% to 81.8%. The highest EPG was observed in *A. lumbricoides* infections (2,361.8) followed by *T. trichiura* (230.5), and hookworm (102.8).

The cumulative prevalence for STH and range of prevalence (0%, >0-<1%, ≥1-10%, ≥10-<20%, ≥20-<50% and ≥50%) by parasite species among the provinces are shown in Figures 2a-2d. The cumulative prevalence of the STH by province and intensity of infection are given in Supplementary Table 2. The mean prevalence of STH among the four districts in the National Capital Region (NCR) was 21.8%. District 1 (Manila) had the highest prevalence followed by District 2 (Mandaluyong, Marikina, Pasig, Quezon City, San Juan), District 3 (Caloocan, Malabon, Navotas, Valenzuela), and District 4 (Las Piñas, Makati, Muntinlupa, Paranaque, Pasay, Pateros, Taguig). Except for Ilocos Norte, *A. lumbricoides* infection was detected in all provinces. The provinces with the highest prevalence were Sorsogon (68.1%) and Masbate (56.4%). The prevalence of this parasite ranged from 1 to below 10% in Abra, Antique, Apayao, Batanes, Benguet, Bohol, Bukidnon, Bulacan, Cagayan, Camiguin, Compostela Valley, Davao del Norte, Davao del Sur, Guimaras, Isabela, Ifugao, Kalinga, Mountain Province, Negros Oriental, Quirino, and Siquijor. Twenty-eight provinces recorded a prevalence between 10% to <20%, and the remaining 25 provinces had a prevalence ranging between 20% to <50% (see Figure 2b). Provinces with more than 50% prevalence of *T. trichiura* were Catanduanes, Masbate, Northern Samar, and Sorsogon (Figure 2c). Twenty-seven provinces had prevalence ranging from 20% to <50%, 20 provinces had prevalence of 10% to <20%, and 27 provinces had prevalence of less than 10%. Prevalence of hookworm was lowest among the three soil-transmitted helminths.

Hookworm was not detected in 48 provinces and in the National Capital Region (NCR). Hookworm prevalence of <4.0% was observed in 30 provinces, mostly in Mindanao and Visayas islands; few cases were detected in Luzon Island (Figure 2d). The highest prevalence was recorded in Zamboanga del Sur, Sarangani, North Cotabato, Agusan Del Sur, and Zamboanga Sibugay.

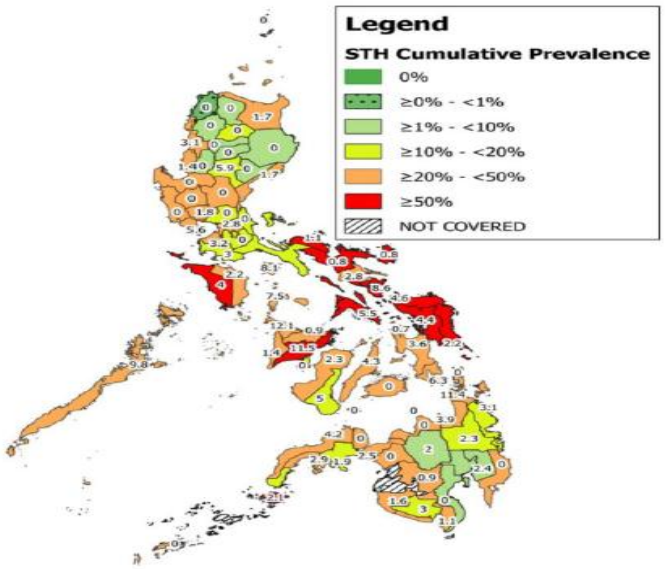

Figure 2a. Map of the Philippines with cumulative prevalence of soil-transmitted helminth (STH) infections in province surveyed

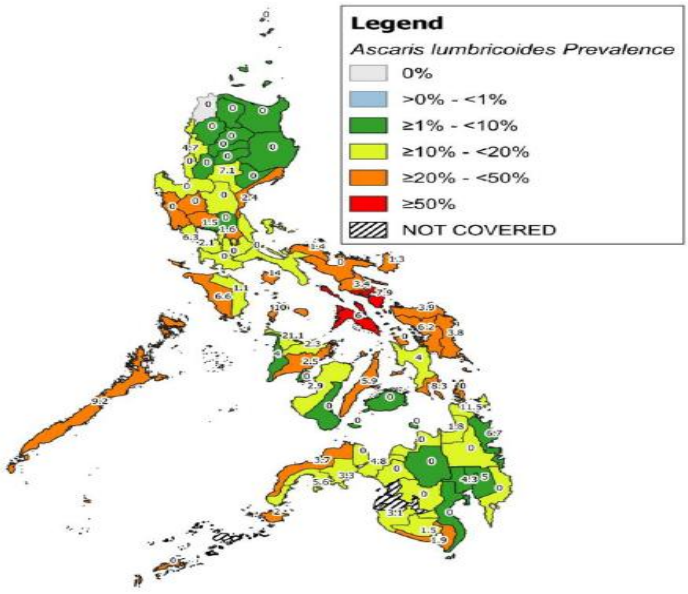

Figure 2b. Map of the Philippines with prevalence of *A. lumbricoides* infections in provinces surveyed

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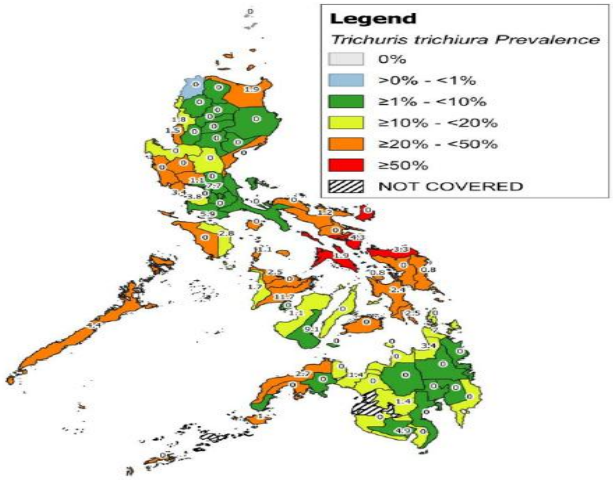

Figure 2c. Map of the Philippines with prevalence of *T. trichiura* infections in provinces surveyed

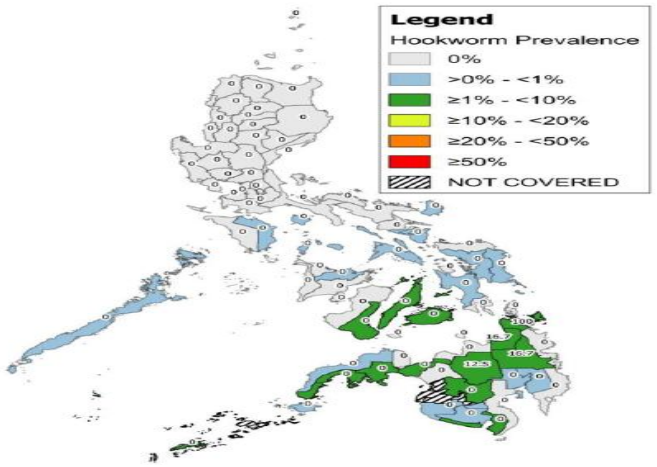

Figure 2d. Map of the Philippines with prevalence of hookworm infections in provinces surveyed

Table 4. Combination of infection with multiple parasites

Combination of multiple parasites	No. (%)	Combination of multiple parasites	No. (%)
Single parasite infection		**Dual parasite infection**	
Trichuris trichiura	2,713 (10.366)	Hookworm + *H. nana*	1 (0.004)
Ascaris lumbricoides	2,117 (8.089)	*S. japonicum* + Heterophyid	1 (0.004)
Schistosoma japonicum	111 (0.424)	*E. vermicularis* + Heterophyid	1 (0.004)
Heterophyid	97 (0.371)	Subtotal	2,434 (9.300)
Enterobius vermicularis	90 (0.344)	**Triple parasite infection**	
Hookworm	68 (0.260)	*A. lumbricoides* + *T. trichiura* + *S. japonicum*	47 (0.180)
Hymenolepis nana	1 (0.004)	*A. lumbricoides* + *T. trichiura* + *E. vermicularis*	23 (0.088)
E. histolytica	1 (0.004)	*A. lumbricoides* + *T. trichiura* + Hookworm	13 (0.050)
Subtotal	5,198 (19.862)	*A. lumbricoides* + *T. trichiura* + Heterophyid	8 (0.031)
Dual parasite infection		*A. lumbricoides* + Hookworm + *S. japonicum*	5 (0.019)
A. lumbricoides + *T. trichiura*	2,249 (8.593)	*A. lumbricoides* + *T. trichiura* + *H. nana*	1 (0.004)
T. trichiura + *S. japonicum*	33 (0.126)	*A. lumbricoides* + Hookworm + Heterophyid	1 (0.004)
A. lumbricoides + *S. japonicum*	23 (0.088)	*T. trichiura* + Hookworm + Heterophyid	1 (0.004)
A. lumbricoides + Hookworm	22 (0.084)	*A. lumbricoides* + *S. japonicum* + *E. vermicularis*	1 (0.004)
T. trichiura + Heterophyid	22 (.0.084)	*A. lumbricoides* + *E. vermicularis* + Heterophyid	1 (0.004)
A. lumbricoides + *E. vermicularis*	21 (0.080)	*T. trichiura* + *E. vermicularis* + Heterophyid	1 (0.004)
T. trichiura + Hookworm infection	21 (0.080)	Subtotal	102 (0.390)
A. lumbricoides + Heterophyid	17 (0.065)	**Quadruple parasite infection**	
T. trichiura + *E. vermicularis*	17 (0.065)	*A. lumbricoides* + *T. trichiura* + Hookworm + *S. japonicum*	7 (0.027)
S. japonicum + *E. vermicularis*	2 (0.008)	*A. lumbricoides* + *T. trichiura* + *S. japonicum* + Heterophyid	1 (0.004)
Hookworm + Heterophyid	2 (0.008)	**Quintuplet parasite infection**	
A. lumbricoides + *H. nana*	1 (0.004)	*A. lumbricoides* + *T. trichiura* + Hookworm + *S. japonicum* + *E. vermicularis*	1 (0.004)
Hookworm + *S. japonicum*	1 (0.004)	**No parasite infection**	18,731 (71.572)

Infections with more than one parasite, and with food-borne and other intestinal parasites

Twenty percent of the examined school children were infected with a single parasite, the most common of which was *T. trichiura* followed by *A. lumbricoides*.

Infection with two parasites was observed in 9.3% of the school children examined and over 90% were co-infections with *A. lumbricoides* and *T. trichiura* (Table 4).

Almost 68% of the infections were with one parasite and 32% were with two or more parasites.

The provinces where more than 10% of the school children had infections with these two parasites were Catanduanes (25.2%), Eastern Samar (19.4%), Masbate (45.3%), Occidental Mindoro (15.3%), Palawan (24.7%), (Sorsogon (60.1%), Surigao del Norte (16.1%), Tawi-Tawi (15.2%), Western Samar (29.4%) and Zamboanga del Norte (16.8%). Three hundred fourteen school children (1.2%) were observed to be infected with food-borne and other intestinal parasites. The most common was *Enterobius vermicularis* (n=158, 0.60%), followed by heterophyids (n=154, 0.59%), and *Hymenolepis nana* (n=3, 0.01%). *Enterobius vermicularis*, and heterophyids were detected in school children from various provinces in Mindanao, Visayas, and Luzon. *H. nana* was observed in Tawi-Tawi (n=2) and Lanao del Norte (n=1).

Intensity of Infection

Ascaris lumbricoides

Heavy-intensity infection was found in 3.2% (n=166) of the school children positive with *A. lumbricoides*. Aklan had the highest proportion of heavy-intensity infections (21.1%) followed by Marinduque (14.0%), Surigao del Norte (11.5%), and Romblon (10.0%). Twenty-nine percent of all of the school children had moderate intensity of infection with this parasite. Iloilo, Bataan, Camarines Norte, Surigao del Norte and Dinagat Islands had the highest number of moderate intensity of infections with this roundworm. The proportion of moderate intensity of infection between 20% to <50% was observed in 50 provinces, while 11 provinces had less than 20% moderate intensity infection. The infections in Batanes, Siquijor, Ifugao, Benguet, and Mountain Province were of light intensity.

In the highly-urbanized NCR, the prevalence of *A. lumbricoides* was 24.4% in the First District, 14.4% in the Third District, 13.2% in the Second District, and 10.6% in the Fourth District. The proportion of heavy intensity of infection was 4.5% in District 1 and 8.3% in District 3.

More than half of infected students with moderate-intensity infection were observed in Districts 1 (50.8%) and 3 (54.2%), while 24.7% was recorded in District 2 and 33.3% in District 4. The prevalence and intensity of infection with *A. lumbricoides* in the province by regions is shown in Supplementary Table 3.

Trichuris trichiura

Across all provinces, *T. trichiura* infections were predominantly of light intensity (80.88%). In decreasing order, the provinces with the highest proportion of heavy-intensity infection were Iloilo, Negros Oriental, Rizal, Surigao del Norte (7.0%), and Batangas. The NCR districts had a prevalence between 4.2% and 8.0% and were light-intensity infections. Supplementary Table 4 shows the prevalence and intensity of infection with *T. trichiura* in the province by regions.

Hookworm

No infection with hookworm was observed in 21 provinces in Regions 1, 2, 3, 4A, four districts of NCR and CAR. It was detected in one school child in Capiz (region 6). Hookworm was prevalent in all but eight of the 21 provinces in Mindanao and 90% of the infections were light-intensity. Although the overall number of infected children was very low, moderate and heavy-intensity infections were observed in Zamboanga del Sur, Agusan del Norte, Agusan del Sur, Surigao del Norte and Bukidnon. Supplementary Table 5 shows the prevalence and intensity of infection with hookworms in the province by regions.

***Schistosoma japonicum* Prevalence and Intensity of Infection**

The overall prevalence of schistosomiasis among the school children was 0.94% (233/26,171) and ranged from 0.0% to 10.0%. While 73% of these infections were low intensity, 8.8% and 17.2% were heavy and moderate intensity of infection, respectively.

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Tangcalagan DA, Daga CM, Tan A, Reyes RA, Macalinao MLM, Mationg ML, et al. The 2013-2015 Nationwide Prevalence Survey of Soil-Transmitted Helminths (STH) and Schistosomiasis among School-Age Children in Public Schools in the Philippines
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In decreasing order, the highest prevalence was observed in Northern Samar, Agusan del Norte, Sorsogon, Bukidnon, North Cotabato, Agusan del Sur, Davao del Sur, and Lanao del Sur. *S. japonicum* infection was not detected among the school children in two known endemic areas: Bohol and Compostela Valley. The parasite, however, was detected in a child from each of these non-SE provinces: Ilocos Norte, Biliran, Tawi-tawi, Basilan, and Dinagat Islands. Please see Figure 3 and Supplementary Table 6.

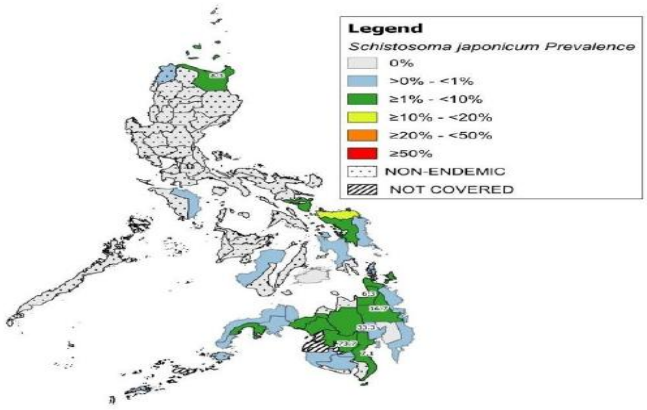

Figure 3. Map of the Philippines with prevalence of S. japonicum infections in provinces surveyed

Prevalence by Age Group and Sex

The cumulative prevalence of the parasites was observed to decrease by increasing age groups. Except for children between the ages of 5 to 7 years, male children had significantly higher cumulative prevalence rates than female children. The distribution of infections of the parasite species by sex and age groups are illustrated in Figure 4. The prevalence of *A. lumbricoides* across the three younger age groups was comparable and was observed to be lower in the oldest age groups. Especially among male children, infections with *T. trichiura* increased by age group but dropped significantly in the 13 to 16 year old. For these two parasites, male school children had significantly higher infections rates than female children, except for the youngest age group. Hookworm infection, on the other hand, was significantly higher among the two older age groups and infection significantly higher among male children. For *S. japonicum*, the prevalence of infection increased with age. Although infection in males were higher than female children, these were not significant.

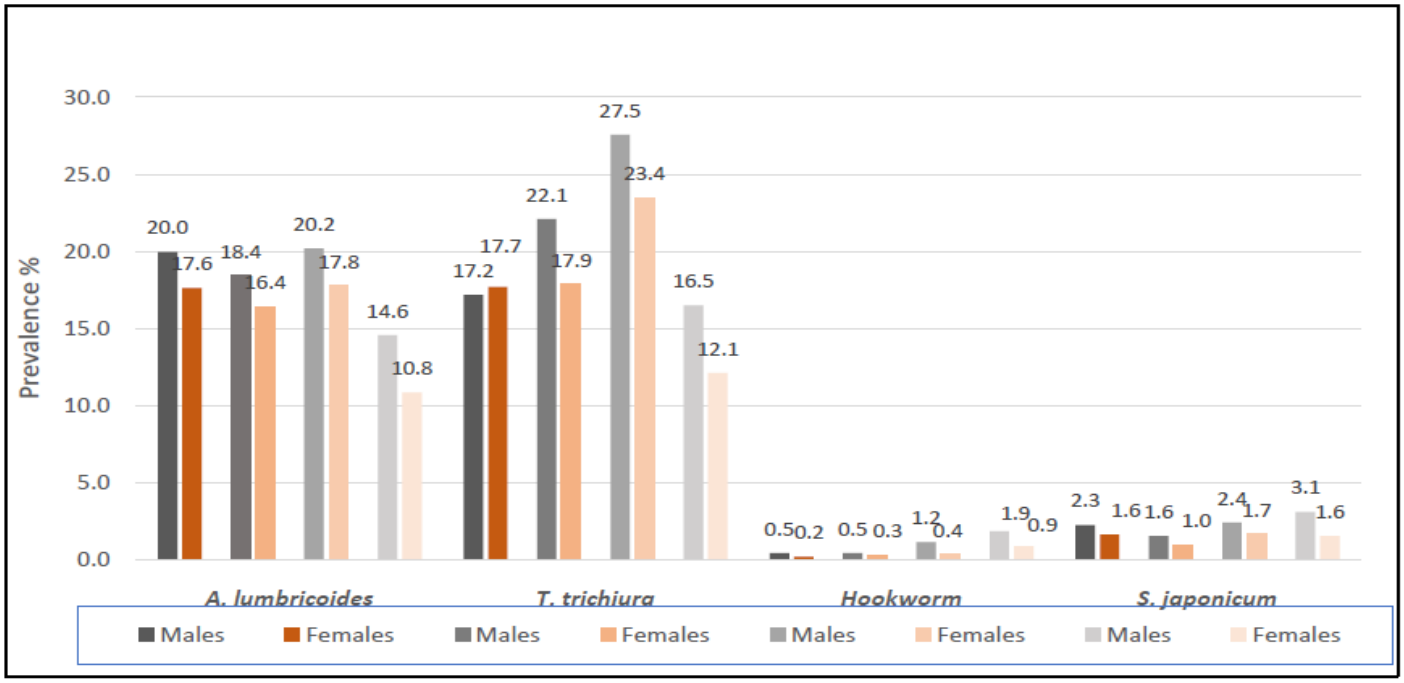

Figure 4. Distribution of age-groups and sex-specific STH and schistosomiasis prevalence in school-age children in the Philippines (2013-2015)

DISCUSSION

The purpose of this nationwide survey was to determine the prevalence of STH and schistosomiasis, and intensity of these infections among school-aged children between 5 to 16 years old. The cumulative STH prevalence and the percent of heavy-intensity infection observed were lower than those reported in 2009**:** 28% vs. 54% and 3.3% vs. 23.1%, respectively.[8] The provinces surveyed in that study were Bulacan and Camarines Sur in Luzon, Negros Occidental and Leyte in Visayas, and Compostela Valley and Surigao del Norte in Mindanao. Those provinces were selected as representative for the region where they belong and not the country in general, whereas in this survey, each province has been represented. The low prevalence and percent of moderate and heavy-intensity infections found in this survey may be attributed to the bi-annual mass drug administration (MDA) of single-dose albendazole 400 mg and praziquantel consistently implemented by the DOH for more than 10 years. Data from the STH National Program shows MDA using albendazole among school-aged children had a coverage that ranged from 42% to 61% from 2011 to 2015 (pers. comm. Palasi W., 2021). Majority of the infections among the school children were with single parasites; however, there were a considerable number of students with two or more parasitic infections. A study in Leyte in 2005 revealed that children with light-intensity infections with single parasites had significantly reduced hemoglobin (Hb) levels compared to children without parasitic infections and this reduction in Hb increased among children with three or four parasitic infections.[16]

We believe that the prevalence of hookworm in this survey was underestimated. Hookworm was the most prevalent intestinal parasite in a survey of 19,000 (17.0%) school children in Benin.[17] Among 478 school children in Cagayan Valley, the prevalence was 2.72%.[18]

From surveys for schistosomiasis among households in selected provinces in Luzon and in Maguindanao, the prevalence of hookworm was 4.6% and 0.3%, respectively.[18] In the first study, stools were examined for hookworm eggs within 60 minutes after the slide was prepared, while in the second, within two hours after collection. In the later study, the authors explained that the delay in examining the stools might have contributed to the low prevalence observed for hookworms. For this survey, in addition to Kato-Katz's low sensitivity in detecting hookworm, the delay in examining of the stools and conditions under which they were transported may have contributed to the overall low hookworm prevalence observed.

The overall prevalence of *S. japonicum* infections (0.89%) and percent of heavy-intensity infection (4.68%) in this survey was lower than the 2.5% national prevalence reported by the Schistosomiasis active surveillance in 2008.[19] Unfortunately, no documented formal investigations (e.g., presence of infected vectors) were made regarding the detection of schistosomiasis infected school children in non-SE provinces. The detection of heterophyids among school children in 33 provinces (mainly in Mindanao) and *H. nana* in four provinces also in Mindanao, brings attention to the dire neglect of these parasitic infections which have already been reported locally in the past.[20,21]

The required number of school children enrolled in the survey was twice that of school children from NSE. In addition, only schistosomiasis endemic municipalities and barangays were purposely included in the sampling frame. This created a bias to increase the probability of detecting schistosomiasis; hence, the findings of the study may not be compared with the previous national prevalence study by Leonardo and colleagues.[19] However, the survey estimated the prevalence of schistosomiasis in endemic areas and can be used to gauge the interventions of the Schistosomiasis Control and Elimination Program (SCEP).

The study also attempted to apply the WHO sampling design to estimate STH and schistosomiasis prevalence in other age groups similar to previous studies.[11] Status of the provinces' schistosomiasis endemicity and grade level (as proxy indicator of age) were the stratifying variables used. Ninety-three percent of the targeted 28,000 specimens were collected in this survey. WHO criteria states that 250 would be needed to estimate the STH and/or schistosomiasis prevalence in an area.

CONCLUSION

Despite the decades of mass drug administration and WASH, STH and schistosomiasis continue to be important infections in school-aged children in public schools of the Philippines. The survey recorded a decrease in the overall prevalence of STHs and schistosomiasis as compared to previous local studies. However, the STH cumulative prevalence (28.4%), and moderate and heavy intensity of infection (29.0% and 3.2%, respectively) are above the Department of Health targets of STH cumulative prevalence of below 20%, and moderate and heavy intensity of infection below 2%. Though resource-intensive, implementing a national prevalence survey for STH and schistosomiasis is a much-needed assessment of the impact of the Department of Health's interventions to reduce the burden of these infections. This survey has identified provinces that may be selected as sentinel sites for regular prevalence surveys.

CHALLENGES

The duration of the national prevalence survey was originally planned for one year. A few events caused it to extend to three years. The September 2013 armed conflict in Zamboanga City prevented any activity in the region. In 2015, security concerns prevented survey staff from collecting samples in Sulu and Maguindanao. Eastern Visayas (Region VIII) was devastated by Typhoon Yolanda in November 2013.

Sample collection stalled a few times due to financial and logistical setbacks. It was only in 2015 that a sizable budget was secured and allowed hiring of full-time medical technologist to perform stool examination. Changes to the schedule of the MDAs also affected the timeline of sample collections. The limited number of personnel handling a high volume of samples made it difficult to have samples examined within 30 minutes of preparation. Other methods such as FLOTAC or examining three stool samples by Kato-Katz could result in more accurate results but would entail higher expense and workload for survey personnel. Requesting for three stool samples from participants, as opposed to only one, could also result in a decrease or inconsistency in participation rate.

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DECLARATIONS

Availability of Data and Materials

The datasets used and analyzed during this study are not publicly available due to the inclusion of identifying information on individuals but are available from the corresponding author on reasonable request and approval from relevant ethics committees.

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Supplementary Table 1. Computation of Power

Study parameters:

alpha = 0.0500
N = 26,171
delta = 0.0140 (maximum allowable error)
p0 = 0.2800 (cumulative incidence from study)
pa = 0.2940

Estimated power:

power = 0.9988

Supplementary Table 2. Cumulative prevalence of STH infections by province, 2013-2015.

Region	Province	No. of students examined	Cumulative prevalence (%)	Intensity of infection (%)		
				Light	Moderate	Heavy
1	ILOCOS NORTE	203	1 (0.5)	1 (100.0)	0 (0.0)	0 (0.0)
	ILOCOS SUR	279	64 (22.9)	37 (57.8)	25 (39.0)	2 (3.1)
	LA UNION	231	70 (30.3)	55 (78.6)	14 (20.0)	1 (1.4)
	PANGASINAN	179	36 (20.1)	27 (75.0)	9 (25.0)	0 (0.0)
	Total	892	171 (19.2)	120 (7.0)	48 (28.1)	3 (1.8)
2	BATANES	155	4 (2.6)	4 (100.0)	0 (0.0)	0 (0.0)
	CAGAYAN*	493	120 (24.3)	84 (70.0)	34 (28.3)	2 (1.7)
	ISABELA	282	22 (7.8)	19 (86.4)	3 (13.6)	0 (0.0)
	NUEVA VIZCAYA	131	17 (13.0)	13 (76.5)	3 (17.6)	1 (5.9)
	QUIRINO	307	15 (4.9)	13 (86.7)	2 (13.3)	0 (0.0)
	Total	1,368	178 (13.0)	133 (74.7)	42 (23.6)	3 (1.7)
3	AURORA	174	60 (34.5)	44 (73.3)	15 (25.0)	1 (1.7)
	BATAAN	142	36 (25.4)	22 (61.1)	12 (33.3)	2 (5.6)
	BULACAN	215	30 (14.0)	26 (86.7)	4 (13.3)	0 (0.0)
	NUEVA ECIJA	228	52 (22.8)	35 (67.3)	17 (32.7)	0 (0.0)
	PAMPANGA	234	113 (48.3)	77 (68.1)	34 (30.1)	2 (1.8)
	TARLAC	195	81 (41.5)	58 (71.6)	23 (28.4)	0 (0.0)
	ZAMBALES	140	59 (42.1)	55 (93.2)	4 (6.8)	0 (0.0)
	Total	1,328	431 (32.5)	317 (73.5)	109 (25.3)	5 (1.2)
4A	BATANGAS	244	33 (13.5)	19 (57.6)	13 (39.4)	1 (3.0)
	CAVITE	260	63 (24.2)	36 (57.1)	25 (39.7)	2 (3.2)
	LAGUNA	188	33 (17.6)	20 (60.6)	13 (39.4)	0 (0.0)
	QUEZON	204	35 (17.2)	30 (85.7)	5 (14.3)	0 (0.0)
	RIZAL	255	71 (27.8)	52 (73.2)	17 (23.9)	2 (2.8)
	Total	1,151	235 (20.4)	157 (66.8)	73 (31.1)	5 (2.1)
4B	MARINDUQUE	215	86 (40.0)	61 (70.9)	18 (20.9)	7 (8.1)
	OCCIDENTAL MINDORO	222	126 (56.8)	83 (65.9)	38 (30.2)	5 (4.0)
	ORIENTAL MINDORO	481	135 (28.1)	93 (68.9)	39 (28.9)	3 (2.2)
	PALAWAN	275	133 (48.4)	68 (51.1)	52 (39.1)	13 (9.8)
	ROMBLON	259	107 (41.3)	64 (59.8)	35 (32.7)	8 (7.5)
	Total	1,452	587 (40.4)	369 (62.9)	182 (31.0)	36 (6.1)
5	ALBAY	241	106 (44.0)	71 (67.0)	32 (30.2)	3 (2.8)
	CAMARINES NORTE	154	88 (57.1)	42 (47.7)	45 (51.1)	1 (1.1)
	CAMARINES SUR	255	133 (52.2)	75 (56.4)	57 (42.9)	1 (0.8)
	CATANDUANES	202	128 (63.4)	63 (49.2)	64 (50.0)	1 (0.8)
	MASBATE	236	183 (77.5)	87 (47.5)	86 (47.0)	10 (5.5)
	SORSOGON	429	384 (89.5)	183 (47.7)	168 (43.8)	33 (8.6)
	Total	1,517	1,022 (67.4)	521 (51.0)	452 (44.2)	49 (4.8)
6	AKLAN	316	107 (33.9)	67 (62.6)	27 (25.2)	13 (12.1)
	ANTIQUE	315	74 (23.5)	60 (81.1)	13 (17.6)	1 (1.4)

Region	Province	No. of students examined	Cumulative prevalence (%)	Intensity of infection (%)		
				Light	Moderate	Heavy
	CAPIZ	260	107 (41.2)	74 (69.2)	32 (29.9)	1 (0.9)
	GUIMARAS	283	35 (12.4)	31 (88.6)	4 (11.4)	0 (0.0)
	ILOILO	255	130 (51.0)	51 (39.2)	64 (49.2)	15 (11.5)
	NEGROS OCCIDENTAL	619	133 (21.5)	112 (84.2)	18 (13.5)	3 (2.3)
	Total	2,048	586 (28.6)	395 (67.4)	158 (27.0)	33 (5.6)
7	BOHOL	657	160 (24.4)	155 (96.9)	5 (3.1)	0 (0.0)
	CEBU	366	138 (37.7)	97 (70.3)	35 (25.4)	6 (4.3)
	NEGROS ORIENTAL	327	40 (12.2)	37 (92.5)	1 (2.5)	2 (5.0)
	SIQUIJOR	303	11 (3.6)	9 (81.8)	2 (18.2)	0 (0.0)
	Total	1,653	349 (21.1)	298 (85.4)	43 (12.3)	8 (2.3)
8	BILIRAN	295	139 (47.1)	88 (63.3)	50 (36.0)	1 (0.7)
	EASTERN SAMAR	506	273 (54)	202 (74.0)	65 (23.8)	6 (2.2)
	LEYTE	443	165 (37.2)	130 (78.8)	29 (17.6)	6 (3.6)
	NORTHERN SAMAR	589	434 (73.7)	208 (47.9)	206 (47.5)	20 (4.6)
	SOUTHERN LEYTE	264	112 (42.4)	69 (61.6)	36 (32.1)	7 (6.3)
	WESTERN SAMAR	445	298 (67.0)	173 (58.1)	112 (37.6)	13 (4.4)
	Total	2,542	1,421 (55.9)	870 (61.2)	498 (35.0)	53 (3.7)
9	ZAMBOANGA DEL NORTE	546	190 (34.8)	107 (56.3)	75 (39.5)	8 (4.2)
	ZAMBOANGA DEL SUR	597	107 (17.9)	90 (84.1)	15 (14.0)	2 (1.9)
	ZAMBOANGA SIBUGAY	481	140 (29.1)	114 (81.4)	22 (15.7)	4 (2.9)
	Total	1,624	437 (26.9)	311 (71.2)	112 (25.6)	14 (3.2)
10	BUKIDNON	522	50 (9.6)	42 (84.0)	7 (14.0)	1 (2.0)
	CAMIGUIN	231	36 (15.6)	29 (80.6)	7 (19.4)	0 (0.0)
	LANAO DEL NORTE	426	118 (27.7)	92 (78.0)	23 (19.5)	3 (2.5)
	MISAMIS OCCIDENTAL	365	89 (24.4)	66 (74.2)	23 (25.8)	0 (0.0)
	MISAMIS ORIENTAL	265	71 (26.8)	53 (74.6)	18 (25.4)	0 (0.0)
	Total	1,809	364 (20.1)	282 (77.5)	78 (21.4)	4 (1.1)
11	COMPOSTELA VALLEY	550	41 (7.5)	39 (95.1)	1 (2.4)	1 (2.4)
	DAVAO DEL NORTE	527	47 (8.9)	42 (89.4)	4 (8.5)	1 (2.1)
	DAVAO DEL SUR	461	40 (8.7)	33 (82.5)	7 (17.5)	0 (0.0)
	DAVAO ORIENTAL	541	121 (22.4)	118 (97.5)	3 (2.5)	0 (0.0)
	Total	2,079	249 (12.0)	232 (93.2)	15 (6.0)	2 (0.8)
12	NORTH COTABATO	551	114 (20.7)	91 (79.8)	22 (19.3)	1 (0.9)
	SARANGANI	265	87 (32.8)	72 (82.8)	14 (16.1)	1 (1.1)
	SOUTH COTABATO	558	99 (17.7)	82 (82.8)	14 (14.1)	3 (3.0)
	SULTAN KUDARAT	508	123 (24.2)	99 (80.5)	22 (17.9)	2 (1.6)
	Total	1,882	423 (22.5)	344 (81.3)	72 (17.0)	7 (1.7)
CARAGA	AGUSAN DEL NORTE	369	97 (26.3)	67 (69.1)	26 (26.8)	4 (4.1)
	AGUSAN DEL SUR	216	43 (19.9)	31 (72.1)	11 (25.6)	1 (2.3)
	DINAGAT ISLANDS	224	69 (30.8)	35 (50.7)	34 (49.3)	0 (0.0)
	SURIGAO DEL NORTE	337	69 (20.5)	31 (44.9)	30 (43.5)	8 (11.6)
	SURIGAO DEL SUR	279	32 (11.5)	25 (78.1)	6 (18.8)	1 (3.1)
	Total	1,425	310 (21.8)	189 (61.0)	107 (34.5)	14 (4.5)
NCR	NCR 1ST DISTRICT	250	75 (30.0)	43 (57.3)	32 (42.7)	0 (0.0)
	NCR 2ND DISTRICT	167	31 (18.6)	24 (77.4)	6 (19.4)	1 (3.2)
	NCR 3RD DISTRICT	167	31 (18.6)	16 (51.6)	13 (41.9)	2 (6.5)
	NCR 4TH DISTRICT	141	21 (14.9)	15 (71.4)	6 (28.6)	0 (0.0)
	Total	725	158 (21.8)	98 (62.0)	57 (3.2)	3 (1.9)
CAR	ABRA	252	11 (4.4)	9 (81.8)	2 (18.2)	0 (0.0)

Region	Province	No. of students examined	Cumulative prevalence (%)	Intensity of infection (%)		
				Light	Moderate	Heavy
	APAYAO	307	22 (7.2)	19 (86.4)	3 (13.6)	0 (0.0)
	BENGUET	230	8 (3.5)	8 (100.0)	0 (0.0)	0 (0.0)
	IFUGAO	282	22 (7.8)	21 (95.5)	1 (4.5)	0 (0.0)
	KALINGA	275	38 (13.8)	34 (89.5)	4 (10.5)	0 (0.0)
	MOUNTAIN PROVINCE	292	16 (5.5)	14 (87.5)	2 (12.5)	0 (0.0)
	Total	1,638	117 (7.1)	105 (89.7)	12 (10.3)	0 (0.0)
ARMM	BASILAN	240	143 (59.6)	91 (63.6)	49 (34.3)	3 (2.1)
	LANAO DEL SUR	601	149 (24.8)	124 (83.2)	25 (16.8)	0 (0.0)
	TAWI-TAWI	197	96 (48.7)	74 (77.1)	22 (22.9)	0 (0.0)
	Total	1,038	388 (37.4)	289 (74.5)	96 (24.7)	3 (0.8)
Total		**26,171**	**7,426 (28.4)**	**5,030 (67.7)**	**2,154 (29.0)**	**242 (3.2)**

Supplementary Table 3. *Ascaris lumbricoides* prevalence and intensity of infection by province

Region	Province	No. of students examined	*A. lumbricoides* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
1	ILOCOS NORTE	203	0	0.0.0-0.0.0	0	0	0
	ILOCOS SUR	279	43 (15.4)	11.6-20.2	20 (46.5)	21 (48.8)	2 (4.7)
	LA UNION	231	25 (10.8)	7.4-15.6	18 (72.0)	7 (28.0)	0
	PANGASINAN	179	24 (13.4)	9.1-19.3	15 (62.5)	9 (37.5)	0
	Total	892	92 (10.3)	8.5-12.5	53 (57.6)	37 (40.2)	2 (2.2)
2	BATANES	155	3 (1.9)	0.6-5.9	3 (100.0)	0	0
	CAGAYAN*	493	36 (7.3)	5.3-10	24 (66.7)	12 (33.3)	0
	ISABELA	282	18 (6.4)	4.0-9.9	15 (83.3)	3 (16.7)	0
	NUEVA VIZCAYA	131	14 (10.7)	6.4-17.3	10 (71.4)	3 (21.4)	1 (7.1)
	QUIRINO	307	11 (3.6)	2.0-6.4	9 (81.8)	2 (18.2)	0
	Total	1,368	82 (6.0)	4.9-7.4	61 (74.4)	20 (24.4)	1 (1.2)
3	AURORA	174	41 (23.6)	17.8-30.5	26 (63.4)	14 (34.1)	1 (2.4)
	BATAAN	142	16 (11.3)	7.0-17.7	4 (25.0)	11 (68.8)	1 (6.3)
	BULACAN	215	21 (9.8)	6.4-14.6	20 (95.2)	1 (4.8)	0
	NUEVA ECIJA	228	38 (16.7)	12.3-22.1	24 (63.2)	14 (36.8)	0
	PAMPANGA	234	68 (29.1)	23.6-35.2	37 (54.4)	30 (44.1)	1 (1.5)
	TARLAC	195	55 (28.2)	22.3-35.0	36 (65.5)	19 (34.5)	0
	ZAMBALES	140	32 (22.9)	16.6-30.6	29 (90.6)	3 (9.4)	0
	Total	1,328	271 (20.4)	18.3-22.7	176 (64.9)	92 (33.9)	3 (1.1)
4A	BATANGAS	244	26 (10.7)	7.3-15.2	14 (53.8)	12 (46.2)	0
	CAVITE	260	48 (18.5)	14.2-23.7	23 (47.9)	24 (50.0)	1 (2.1)
	LAGUNA	188	26 (13.8)	9.6-19.6	15 (57.7)	11 (42.3)	0
	QUEZON	204	21 (10.3)	6.8-15.3	16 (76.2)	5 (23.8)	0
	RIZAL	255	64 (25.1)	20.1-30.8	47 (73.4)	16 (25.0)	1 (1.6)
	Total	1,151	185 (16.1)	14.1-18.3	115 (62.2)	68 (36.8)	2 (1.1)
4B	MARINDUQUE	215	50 (23.3)	18.1-29.4	30 (60.0)	13 (26.0)	7 (14.0)
	OCCIDENTAL MINDORO	222	76 (34.2)	28.2-40.8	42 (55.3)	29 (38.2)	5 (6.6)
	ORIENTAL MINDORO	481	92 (19.1)	15.8-22.9	56 (60.9)	35 (38.0)	1 (1.1)
	PALAWAN	275	87 (31.6)	26.4-37.4	30 (34.5)	49 (56.3)	8 (9.2)
	ROMBLON	259	70 (27.0)	21.9-32.8	29 (41.4)	34 (48.6)	7 (10.0)
	Total	1,452	375 (25.8)	23.6-28.1	187 (49.9)	160 (42.7)	28 (7.5)
5	ALBAY	241	87 (36.1)	30.2-42.4	54 (62.1)	30 (34.5)	3 (3.4)
	CAMARINES NORTE	154	72 (46.8)	38.9-54.7	28 (38.9)	43 (59.7)	1 (1.4)

Region	Province	No. of students examined	*A. lumbricoides* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
	CAMARINES SUR	255	102 (40.0)	34.1-46.2	50 (49.0)	52 (51.0)	0
	CATANDUANES	202	78 (38.6)	32.1-45.6	37 (47.4)	40 (51.3)	1 (1.3)
	MASBATE	236	133 (56.4)	49.9-62.6	56 (42.1)	69 (51.9)	8 (6.0)
	SORSOGON	429	292 (68.1)	63.5-72.3	119 (40.8)	150 (51.4)	23 (7.9)
	Total	1,517	764 (50.4)	47.8-52.9	344 (45.0)	384 (50.3)	36 (4.7)
6	AKLAN	316	57 (18)	14.2-22.7	26 (45.6)	19 (33.3)	12 (21.1)
	ANTIQUE	315	25 (7.9)	5.4-11.5	16 (64.0)	8 (32)	1 (4.0)
	CAPIZ	260	43 (16.5)	12.5-21.6	25 (58.1)	17 (39.5)	1 (2.3)
	GUIMARAS	283	16 (5.7)	3.5-9.1	12 (75.0)	4 (25.0)	0
	ILOILO	255	80 (31.4)	25.9-37.4	15 (18.8)	63 (78.8)	2 (2.5)
	NEGROS OCCIDENTAL	619	68 (11.0)	8.7-13.7	51 (75.0)	15 (22.1)	2 (2.9)
	Total	2,048	289 (14.1)	12.7-15.7	145 (50.2)	126 (43.6)	18 (6.2)
7	BOHOL	657	16 (2.4)	1.5-3.9	14 (87.5)	2 (12.5)	0
	CEBU	366	102 (27.9)	23.5-32.7	64 (62.7)	32 (31.4)	6 (5.9)
	NEGROS ORIENTAL	327	18 (5.5)	3.5-8.6	17 (94.4)	1 (5.6)	0
	SIQUIJOR	303	3 (1.0)	0.3-3.0	3 (100.0)	0	0
	Total	1,653	139 (8.4)	7.2-9.8	98 (70.5)	35 (25.2)	6 (4.3)
8	BILIRAN	295	68 (23.1)	18.6-28.2	36 (52.9)	32 (47.1)	0
	EASTERN SAMAR	506	132 (26.1)	22.4-30.1	84 (63.6)	43 (32.6)	5 (3.8)
	LEYTE	443	75 (16.9)	13.7-20.7	51 (68.0)	21 (28.0)	3 (4.0)
	NORTHERN SAMAR	589	280 (47.5)	43.5-51.6	117 (41.8)	152 (54.3)	11 (3.9)
	SOUTHERN LEYTE	264	60 (22.7)	18.0-28.2	24 (40.0)	31 (51.7)	5 (8.3)
	WESTERN SAMAR	445	210 (47.2)	42.6-51.9	96 (45.7)	101 (48.1)	13 (6.2)
	Total	2,542	825 (32.5)	30.7-34.3	408 (49.5)	380 (46.1)	37 (4.5)
9	ZAMBOANGA DEL NORTE	546	135 (24.7)	21.3-28.5	72 (53.3)	58 (43.0)	5 (3.7)
	ZAMBOANGA DEL SUR	597	61 (10.2)	8.0-12.9	45 (73.8)	14 (23.0)	2 (3.3)
	ZAMBOANGA SIBUGAY	481	71 (14.8)	11.9-18.2	50 (70.4)	17 (23.9)	4 (5.6)
	Total	1,624	267 (16.4)	14.7-18.3	167 (62.5)	89 (33.3)	11 (4.1)
10	BUKIDNON	522	37 (7.1)	5.2-9.6	29 (78.4)	8 (21.6)	0
	CAMIGUIN	231	22 (9.5)	6.3-14.1	17 (77.3)	5 (22.7)	0
	LANAO DEL NORTE	426	62 (14.6)	11.5-18.2	38 (61.3)	21 (33.9)	3 (4.8)
	MISAMIS OCCIDENTAL	365	54 (14.8)	11.5-18.8	37 (69.8)	16 (30.2)	0
	MISAMIS ORIENTAL	265	39 (14.7)	10.9-19.5	24 (61.5)	15 (38.5)	0
	Total	1,809	214 (11.8)	10.4-13.4	145 (68.1)	65 (30.5)	3 (1.4)
11	COMPOSTELA VALLEY	550	20 (3.6)	2.4-5.6	18 (90.0)	1 (5.0)	1 (5.0)
	DAVAO DEL NORTE	527	23 (4.4)	2.9-6.5	19 (82.6)	3 (13.0)	1 (4.3)
	DAVAO DEL SUR	461	22 (4.8)	3.2-7.2	16 (72.7)	6 (27.3)	0
	DAVAO ORIENTAL	541	78 (14.4)	11.7-17.6	76 (97.4)	2 (2.6)	0
	Total	2,079	143 (6.9)	5.9-8.1	129 (90.2)	12 (8.4)	2 (1.4)
12	NORTH COTABATO	551	68 (12.3)	9.8-15.4	48 (70.6)	20 (29.4)	0
	SARANGANI	265	68 (12.2)	9.7-15.2	53 (77.9)	14 (20.6)	1 (1.5)
	SOUTH COTABATO	558	54 (20.4)	15.9-25.7	41 (75.9)	12 (22.2)	1 (1.9)
	SULTAN KUDARAT	508	65 (12.8)	10.2-16.0	44 (67.7)	19 (29.2)	2 (3.1)
	Total	1,882	255 (13.5)	12.1-15.2	186 (72.9)	65 (25.5)	4 (1.6)
CARAGA	AGUSAN DEL NORTE	369	57 (15.4)	12.1-19.5	35 (61.4)	21 (36.8)	1 (1.8)
	AGUSAN DEL SUR	216	34 (15.7)	11.4-21.3	23 (67.6)	11 (32.4)	0
	DINAGAT ISLANDS	224	54 (24.1)	18.9-30.2	22 (40.7)	32 (59.3)	0
	SURIGAO DEL NORTE	337	52 (15.4)	11.9-19.7	15 (28.8)	31 (59.6)	6 (11.5)

Region	Province	No. of students examined	*A. lumbricoides* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
	SURIGAO DEL SUR	279	15 (5.4)	3.3-8.8	11 (73.3)	3 (20.0)	1 (6.7)
	Total	1,425	212 (14.9)	13.1-16.8	106 (50.0)	98 (46.2)	8 (3.8)
NCR	NCR 1ST DISTRICT	250	61 (24.4)	19.4-30.1	30 (49.2)	31 (50.8)	0
	NCR 2ND DISTRICT	167	22 (13.2)	8.8-19.3	16 (72.7)	5 (22.7)	1 (4.5)
	NCR 3RD DISTRICT	167	24 (14.4)	9.8-20.6	9 (37.5)	13 (54.2)	2 (8.3)
	NCR 4TH DISTRICT	141	15 (10.6)	6.5-17.0	10 (66.7)	5 (33.3)	0
	Total	725	122 (16.8)	14.3-19.7	65 (53.3)	54 (44.3)	3 (2.5)
CAR	ABRA	252	7 (2.8)	1.3-5.7	5 (71.4)	2 (28.6)	0
	APAYAO	307	11 (3.6)	2-6.4.0	9 (81.8)	2 (18.2)	0
	BENGUET	230	5 (2.2)	0.9-5.1	5 (100.0)	0	0
	IFUGAO	282	14 (5.0)	3.0-8.2	14 (100.0)	0	0
	KALINGA	275	18 (6.5)	4.2-10.2	14 (77.8)	4 (22.2)	0
	MOUNTAIN PROVINCE	292	3 (1.0)	0.3-3.2	3 (100.0)	0	0
	Total	1,638	58 (3.5)	2.7-4.6	50 (86.2)	8 (13.8)	0
ARMM	BASILAN	240	102 (42.5)	36.4-48.9	54 (52.9)	46 (45.1)	2 (2.0)
	LANAO DEL SUR	601	108 (18.0)	15.1-21.3	87 (80.6)	21 (19.4)	0
	TAWI-TAWI	197	57 (28.9)	23.0-35.7	43 (75.4)	14 (24.6)	0
	Total	1,038	267 (25.7)	23.2-28.5	184 (68.9)	81 (30.3)	2 (0.7)
Overall		**26,171**	**4,560 (17.4)**	**16.97-17.89**	**2,619 (57.4)**	**1,774 (38.9)**	**166 (3.6)**

Supplementary Table 4. ***Trichuris trichiura*** **prevalence and intensity of infection per province**

Region	Province	No. of students examined	*T. trichiura* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
1	ILOCOS NORTE	203	1 (0.5)	0.1-3.5	1 (100.0)	0 (0.0)	0 (0.0)
	ILOCOS SUR	279	55 (19.7)	15.4-24.8	41 (74.5)	13 (23.6)	1 (1.8)
	LA UNION	231	65 (28.1)	22.7-34.3	53 (81.5)	11 (16.9)	1 (1.5)
	PANGASINAN	179	20 (11.2)	7.3-16.7	20 (100.0)	0 (0.0)	0 (0.0)
	Total	892	141 (15.8)	13.6-18.4	115 (81.6)	24 (17)	2 (1.4)
2	BATANES	155	1 (0.6)	0.1-4.5	1 (100.0)	0 (0.0)	0 (0.0)
	CAGAYAN*	493	107 (21.7)	18.3-25.6	80 (74.8)	25 (23.4)	2 (1.9)
	ISABELA	282	8 (2.8)	1.4-5.6	8 (100.0)	0 (0.0)	0 (0.0)
	NUEVA VIZCAYA	131	6 (4.6)	2.1-9.9	5 (83.3)	1 (16.7)	0 (0.0)
	QUIRINO	307	7 (2.3)	1.1-4.7	7 (100.0)	0 (0.0)	0 (0.0)
	Total	1,368	129 (9.4)	8.0-11.1	101 (78.3)	26 (20.2)	2 (1.6)
3	AURORA	174	37 (21.3)	15.8-28.0	36 (97.3)	1 (2.7)	0 (0.0)
	BATAAN	142	29 (20.4)	14.5-27.9	25 (86.2)	3 (10.3)	1 (3.4)
	BULACAN	215	11 (5.1)	2.8-9.0	8 (72.7)	3 (27.3)	0 (0.0)
	NUEVA ECIJA	228	24 (10.5)	7.1-15.3	19 (79.2)	5 (20.8)	0 (0.0)
	PAMPANGA	234	88 (37.6)	31.6-44.0	79 (89.8)	8 (9.1)	1 (1.1)
	TARLAC	195	55 (28.2)	22.3-35.0	50 (90.9)	5 (9.1)	0 (0.0)
	ZAMBALES	140	41 (29.3)	22.3-37.4	40 (97.6)	1 (2.4)	0 (0.0)
	Total	1,328	285 (21.5)	19.3-23.8	257 (90.2)	26 (9.1)	2 (0.7)
4A	BATANGAS	244	17 (7.0)	4.4-11.0	13 (76.5)	3 (17.6)	1 (5.9)
	CAVITE	260	26 (10.0)	6.9-14.3	22 (84.6)	3 (11.5)	1 (3.8)
	LAGUNA	188	13 (6.9)	4.0-11.6	11 (84.6)	2 (15.4)	0 (0.0)
	QUEZON	204	18 (8.8)	5.6-13.6	18 (100.0)	0 (0.0)	0 (0.0)
	RIZAL	255	13 (5.1)	3.0-8.6	10 (76.9)	2 (15.4)	1 (7.7)
	Total	1,151	87 (7.6)	6.2-9.2	74 (85.1)	10 (11.5)	3 (3.4)

Region	Province	No. of students examined	*T. trichiura* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
4B	MARINDUQUE	215	61 (28.4)	22.7-34.8	49 (80.3)	12 (19.7)	0 (0.0)
	OCCIDENTAL MINDORO	222	84 (37.8)	31.7-44.4	70 (83.3)	14 (16.7)	0 (0.0)
	ORIENTAL MINDORO	481	72 (15.0)	12.0-18.5	65 (90.3)	5 (6.9)	2 (2.8)
	PALAWAN	275	113 (41.1)	35.4-47.0	85 (75.2)	23 (20.4)	5 (4.4)
	ROMBLON	259	87 (33.6)	28.1-39.6	83 (95.4)	3 (3.4)	1 (1.1)
	Total	1,452	417 (28.7)	26.4-31.1	352 (84.4)	57 (13.7)	8 (1.9)
5	ALBAY	241	62 (25.7)	20.6-31.7	57 (91.9)	5 (8.1)	0 (0.0)
	CAMARINES NORTE	154	101 (50.0)	43.1-56.9	56 (55.4)	45 (44.6)	0 (0.0)
	CAMARINES SUR	255	48 (31.2)	24.3-39.0	39 (81.3)	9 (18.8)	0 (0.0)
	CATANDUANES	202	86 (33.7)	28.2-39.8	71 (82.6)	14 (16.3)	1 (1.2)
	MASBATE	236	157 (66.5)	60.2-72.3	117 (74.5)	37 (23.6)	3 (1.9)
	SORSOGON	429	351 (81.8)	77.9-85.2	238 (67.8)	98 (27.9)	15 (4.3)
	Total	1,517	805 (53.1)	50.5-55.6	578 (71.8)	208 (25.8)	19 (2.4)
6	AKLAN	316	79 (25.0)	20.5-30.1	57 (72.2)	20 (25.3)	2 (2.5)
	ANTIQUE	315	58 (18.4)	14.5-23.1	51 (87.9)	6 (10.3)	1 (1.7)
	CAPIZ	260	97 (37.3)	31.6-43.4	76 (78.4)	21 (21.6)	0 (0.0)
	GUIMARAS	283	22 (7.8)	5.2-11.6	22 (100.0)	0 (0.0)	0 (0.0)
	ILOILO	255	120 (47.1)	41.0-53.2	68 (56.7)	38 (31.7)	14 (11.7)
	NEGROS OCCIDENTAL	619	87 (14.1)	11.5-17.0	82 (94.3)	4 (4.6)	1 (1.1)
	Total	2,048	463 (22.6)	20.8-24.5	356 (76.9)	89 (19.2)	18 (3.9)
7	BOHOL	657	147 (22.4)	19.3-25.7	144 (98.0)	3 (2.0)	0 (0.0)
	CEBU	366	60 (16.4)	12.9-20.6	55 (91.7)	5 (8.3)	0 (0.0)
	NEGROS ORIENTAL	327	22 (6.7)	4.5-10	20 (90.9)	0 (0.0)	2 (9.1)
	SIQUIJOR	303	8 (2.6)	1.3-5.2	6 (75.0)	2 (25.0)	0 (0.0)
	Total	1,653	237 (14.3)	12.7-16.1	225 (94.9)	10 (4.2)	2 (0.8)
8	BILIRAN	295	119 (40.3)	34.9-46.1	85 (71.4)	33 (27.7)	1 (0.8)
	EASTERN SAMAR	506	238 (47.0)	42.7-51.4	195 (81.9)	41 (17.2)	2 (0.8)
	LEYTE	443	126 (28.4)	24.4-32.8	108 (85.7)	15 (11.9)	3 (2.4)
	NORTHERN SAMAR	589	80 (30.3)	25.0-36.2	67 (83.8)	11 (13.8)	2 (2.5)
	SOUTHERN LEYTE	264	361 (61.3)	57.3-65.2	218 (60.4)	131 (36.3)	12 (3.3)
	WESTERN SAMAR	445	221 (49.7)	45.0-54.3	191 (86.4)	30 (13.6)	0 (0.0)
	Total	2,542	1,145 (45)	43.1-47.0	864 (75.5)	261 (22.8)	20 (1.7)
9	ZAMBOANGA DEL NORTE	546	147 (26.9)	23.4-30.8	98 (66.7)	45 (30.6)	4 (2.7)
	ZAMBOANGA DEL SUR	597	50 (8.4)	6.4-10.9	49 (98.0)	1 (2.0)	0 (0.0)
	ZAMBOANGA SIBUGAY	481	100 (20.8)	17.4-24.7	90 (90.0)	10 (10.0)	0 (0.0)
	Total	1,624	297 (18.3)	16.5-20.2	237 (79.8)	56 (18.9)	4 (1.3)
10	BUKIDNON	522	12 (2.3)	1.3-4.0	12 (100.0)	0 (0.0)	0 (0.0)
	CAMIGUIN	231	26 (11.3)	7.8-16.1	21 (91.3)	2 (8.7)	0 (0.0)
	LANAO DEL NORTE	426	71 (16.7)	13.4-20.5	66 (95.7)	2 (2.9)	1 (1.4)
	MISAMIS OCCIDENTAL	365	65 (17.8)	14.2-22.1	53 (84.1)	10 (15.9)	0 (0.0)
	MISAMIS ORIENTAL	265	48 (18.1)	13.9-23.3	39 (86.7)	6 (13.3)	0 (0.0)
	Total	1,809	222 (12.3)	10.8-13.9	191 (90.1)	20 (9.4)	1 (0.5)
11	COMPOSTELA VALLEY	550	21 (3.8)	2.5-5.8	21 (100.0)	0 (0.0)	0 (0.0)
	DAVAO DEL NORTE	527	23 (4.4)	2.9-6.5	22 (95.7)	1 (4.3)	0 (0.0)
	DAVAO DEL SUR	461	25 (5.4)	3.7-7.9	24 (96.0)	1 (4.0)	0 (0.0)
	DAVAO ORIENTAL	541	62 (11.5)	9.0-14.4	61 (98.4)	1 (1.6)	0 (0.0)
	Total	2,079	131 (6.3)	5.3-7.4	128 (97.7)	3 (2.3)	0 (0.0)
12	NORTH COTABATO	551	69 (12.5)	10.0-15.6	63 (91.3)	5 (7.2)	1 (1.4)
	SARANGANI	265	41 (7.3)	5.5-9.8	36 (87.8)	3 (7.3)	2 (4.9)

Region	Province	No. of students examined	*T. trichiura* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
	SOUTH COTABATO	558	50 (18.9)	14.6-24.1	47 (94.0)	3 (6.0)	0 (0.0)
	SULTAN KUDARAT	508	74 (14.6)	11.8-17.9	70 (94.6)	4 (5.4)	0 (0.0)
	Total	1,882	234 (12.4)	11.0-14.0	216 (92.3)	15 (6.4)	3 (1.3)
CARAGA	AGUSAN DEL NORTE	369	65 (17.6)	14.0-21.9	46 (79.3)	10 (17.2)	2 (3.4)
	AGUSAN DEL SUR	216	19 (8.8)	5.7-13.4	18 (100.0)	0 (0.0)	0 (0.0)
	DINAGAT ISLANDS	224	29 (12.9)	9.1-18.1	26 (92.9)	2 (7.1)	0 (0.0)
	SURIGAO DEL NORTE	337	59 (17.5)	13.8-22.0	34 (59.6)	19 (33.3)	4 (7.0)
	SURIGAO DEL SUR	279	27 (9.7)	6.7-13.8	22 (81.5)	5 (18.5)	0 (0.0)
	Total	1,425	199 (14)	12.3-15.9	146 (77.7)	36 (19.1)	6 (3.2)
NCR	NCR 1ST DISTRICT	250	20 (8.0)	5.2-12.1	19 (95.0)	1 (5.0)	0 (0.0)
	NCR 2ND DISTRICT	167	12 (7.2)	4.1-12.3	11 (91.7)	1 (8.3)	0 (0.0)
	NCR 3RD DISTRICT	167	7 (4.2)	2.0-8.6	7 (100.0)	0 (0.0)	0 (0.0)
	NCR 4TH DISTRICT	141	9 (6.4)	3.3-11.9	8 (88.9)	1 (11.1)	0 (0.0)
	Total	725	48 (6.6)	5.0-8.7	45 (93.8)	3 (6.3)	0 (0.0)
CAR	ABRA	252	6 (2.4)	1.1-5.2	6 (100.0)	0 (0.0)	0 (0.0)
	APAYAO	307	13 (4.2)	2.5-7.2	12 (92.3)	1 (7.7)	0 (0.0)
	BENGUET	230	3 (1.3)	0.4-4.0	3 (100.0)	0 (0.0)	0 (0.0)
	IFUGAO	282	10 (3.5)	1.9-6.5	9 (90.0)	1 (10)	0 (0.0)
	KALINGA	275	27 (9.8)	6.8-14.0	26 (96.3)	1 (3.7)	0 (0.0)
	MOUNTAIN PROVINCE	292	15 (5.1)	3.1-8.4	13 (86.7)	2 (13.3)	0 (0.0)
	Total	1,638	74 (4.5)	3.6-5.6	69 (93.2)	5 (6.8)	0 (0.0)
ARMM	BASILAN	240	100 (41.7)	35.6-48.1	88 (88.0)	11 (11.0)	1 (1.0)
	LANAO DEL SUR	601	75 (12.5)	10.1-15.4	70 (93.3)	5 (6.7)	0 (0.0)
	TAWI-TAWI	197	70 (35.5)	29.1-42.5	57 (81.4)	13 (18.6)	0 (0.0)
	Total	1,038	245 (23.6)	21.1-26.3	215 (87.8)	29 (11.8)	1 (0.4)
Overall		**26,171**	**5,159 (19.7)**	**19.2-20.2**	**4,169 (81.1)**	**878 (17.1)**	**91 (1.8)**

Supplementary Table 5. Hookworm prevalence and intensity of infection per province*

Region/s	Province	No. of students examined	Hookworm prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	High
4B	MARINDUQUE	215	1 (0.5)	0.1-3.3	1 (100.0)	0 (0.0)	0 (0.0)
	OCCIDENTAL MINDORO	222	0 (0.0)	--	--	--	--
	ORIENTAL MINDORO	481	1 (0.2)	0.0-1.5	1 (100.0)	0 (0.0)	0 (0.0)
	PALAWAN	275	2 (0.7)	0.2-2.9	2 (100.0)	0 (0.0)	0 (0.0)
	ROMBLON	259	1 (0.4)	0.1-2.7	1 (100.0)	0 (0.0)	0 (0.0)
	Total	1,452	5 (0.3)	0.1-0.8	5 (100.0)	0 (0.0)	0 (0.0)
5	ALBAY	241	0 (0.0)	--	--	--	--
	CAMARINES NORTE	154	1 (0.5)	0.1-3.5	1 (100.0)	0 (0.0)	0 (0.0)
	CAMARINES SUR	255	0 (0.0)	--	--	--	--
	CATANDUANES	202	0 (0.0)	--	--	--	--
	MASBATE	236	1 (0.4)	0.1-3.0	1 (100.0)	0 (0.0)	0 (0.0)
	SORSOGON	429	2 (0.5)	0.1-1.9	2 (100.0)	0 (0.0)	0 (0.0)
	Total	1,517	4 (0.3)	0.1-0.7	4 (100.0)	0 (0.0)	0 (0.0)
6	AKLAN	316	0 (0.0)	--	--	--	--
	ANTIQUE	315	0 (0.0)	--	--	--	--
	CAPIZ	260	1 (0.4)	0.1-2.7	1 (100.0)	0 (0.0)	0 (0.0)

Region/s	Province	No. of students examined	Hookworm prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	High
	GUIMARAS	283	0 (0.0)	--	--	--	--
	ILOILO	255	0 (0.0)	--	--	--	--
	NEGROS OCCIDENTAL	619	0 (0.0)	--	--	--	--
	Total	2,048	1 (0.1)	0.0-0.4	1 (100.0)	0 (0.0)	0 (0.0)
7	BOHOL	657	7 (1.1)	0.5-2.2	7 (100.0)	0 (0.0)	0 (0.0)
	CEBU	366	6 (1.6)	0.7-3.6	6 (100.0)	0 (0.0)	0 (0.0)
	NEGROS ORIENTAL	327	4 (1.2)	0.5-3.2	4 (100.0)	0 (0.0)	0 (0.0)
	SIQUIJOR	303	0 (0.0)	--	--	--	--
	Total	1,653	17 (1.0)	0.6-1.6	17 (100.0)	0 (0.0)	0 (0.0)
8	BILIRAN	295	0 (0.0)	--	--	--	--
	EASTERN SAMAR	506	4 (0.8)	0.3-2.1	4 (100.0)	0 (0.0)	0 (0.0)
	LEYTE	443	2 (0.5)	0.1-1.8	2 (100.0)	0 (0.0)	0 (0.0)
	NORTHERN SAMAR	589	0 (0.0)	--	--	--	--
	SOUTHERN LEYTE	264	0 (0.0)	--	--	--	--
	WESTERN SAMAR	445	2 (0.4)	0.1-1.8	2 (100.0)	0 (0.0)	0 (0.0)
	Total	2,542	8 (0.3)	0.2-0.6	8 (100.0)	0 (0.0)	0 (0.0)
9	ZAMBOANGA DEL NORTE	546	2 (0.4)	0.1-1.5	2 (100.0)	0 (0.0)	0 (0.0)
	ZAMBOANGA DEL SUR	597	24 (4.0)	2.7-5.9	23 (96.0)	1 (4.2)	0 (0.0)
	ZAMBOANGA SIBUGAY	481	10 (2.1)	1.1-3.8	10 (100.0)	0 (0.0)	0 (0.0)
	Total	1,624	36 (2.2)	1.6-3.1	35 (97.0)	1 (2.8)	0 (0.0)
10	BUKIDNON	522	9 (2.0)	1.0-3.0	7 (87.5)	0 (0.0)	1 (12.5)
	CAMIGUIN	231	0 (0.0)	--	--	--	--
	LANAO DEL NORTE	426	9 (2.0)	1.0-4.0	9 (100.0)	0 (0.0)	0 (0.0)
	MISAMIS OCCIDENTAL	365	0 (0.0)	--	--	--	--
	MISAMIS ORIENTAL	265	0 (0.0)	--	--	--	--
	Total	1,809	18 (1.0)	1.0-2.0	16 (94.1)	0 (0.0)	1 (5.9)
11	COMPOSTELA VALLEY	550	1 (0.2)	0.0-1.3	1 (100.0)	0 (0.0)	0 (0.0)
	DAVAO DEL NORTE	527	2 (0.4)	0.1-1.5	2 (100.0)	0 (0.0)	0 (0.0)
	DAVAO DEL SUR	461	0 (0.0)	--	--	--	--
	DAVAO ORIENTAL	541	0 (0.0)	--	--	--	--
	Total	2,079	3 (0.1)	0.0-0.4	3 (100.0)	0 (0.0)	0 (0.0)
12	NORTH COTABATO	551	16 (2.9)	1.8-4.7	16 (100.0)	0 (0.0)	0 (0.0)
	SARANGANI	265	5 (0.9)	0.4-2.1	5 (100.0)	0 (0.0)	0 (0.0)
	SOUTH COTABATO	558	8 (3.0)	1.5-5.9	8 (100.0)	0 (0.0)	0 (0.0)
	SULTAN KUDARAT	508	4 (0.8)	0.3-2.1	4 (100.0)	0 (0.0)	0 (0.0)
	Total	1,882	33 (1.8)	1.2-2.5	33 (100.0)	0 (0.0)	0 (0.0)
CARAGA	AGUSAN DEL NORTE	369	6 (2.0)	1.0-4.0	5 (83.3)	0 (0.0)	1 (16.7)
	AGUSAN DEL SUR	216	6 (3.0)	1.0-6.0	4 (66.7)	1 (16.7)	1 (16.7)
	DINAGAT ISLANDS	224	0 (0.0)	--	--	--	--
	SURIGAO DEL NORTE	337	2 (1.0)	0.0-2.0	0 (0.0)	0 (0.0)	2 (100.0)
	SURIGAO DEL SUR	279	0 (0.0)	--	--	--	--
	Total	1,425	14 (1.0)	1.0-2.0	9 (64.3)	1 (7.1)	4 (28.6)
ARMM	BASILAN	240	1 (0.4)	0.1-2.9	1 (100.0)	0 (0.0)	0 (0.0)
	LANAO DEL SUR	601	0 (0.0)	--	--	--	--
	TAWI-TAWI	197	4 (2.0)	0.8-5.3	4 (100.0)	0 (0.0)	0 (0.0)
	Total	1,038	5 (0.5)	0.2-1.2	5 (100.0)	0 (0.0)	0 (0.0)
Overall		**26,171**	144 (0.6)	0.5-0.7	136 (95.1)	2 (1.4)	5 (3.5)

*No hookworm parasite detected among the school children in the provinces of Regions 1, 2, 3, 4A, NCR, CARAGA and CAR.

Supplementary Table 6. *Schistosoma japonicum* prevalence and intensity of infection per province*

Region	Province	No. of students examined	*S. japonicum* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
1	ILOCOS NORTE	203	1 (0.5)	0.1-3.5	1 (2.0)	0 (0.0)	0 (0.0)
	ILOCOS SUR	279	0 (0.0)	--	--	--	--
	LA UNION	231	0 (0.0)	--	--	--	--
	PANGASINAN	179	0 (0.0)	--	--	--	--
	Total	892	1 (0.1)	0.0-0.8	1 (2.0)	0 (0.0)	0 (0.0)
2	BATANES	155	0 (0.0)	--	--	--	--
	CAGAYAN*	493	12 (2.4)	1.4-4.2	10 (22.0)	1 (8.3)	1 (8.3)
	ISABELA	282	0 (0.0)	--	--	--	--
	NUEVA VIZCAYA	131	0 (0.0)	--	--	--	--
	QUIRINO	307	0 (0.0)	--	--	--	--
	Total	1,368	12 (0.9)	0.5-1.5	10 (22.0)	1 (8.3)	1 (8.3)
4B	MARINDUQUE	215	0 (0.0)	--	--	--	--
	OCCIDENTAL MINDORO	222	0 (0.0)	--	--	--	--
	ORIENTAL MINDORO*	481	1 (0.2)	0.0-1.5	1 (100.0)	0 (0.0)	0 (0.0)
	PALAWAN	275	0 (0.0)	--	--	--	--
	ROMBLON	259	0 (0.0)	--	--	--	--
	Total	1,452	1 (0.1)	0.0-0.5	1 (100.0)	0 (0.0)	0 (0.0)
5	ALBAY	241	0 (0.0)	--	--	--	--
	CAMARINES NORTE	154	0 (0.0)	--	--	--	--
	CAMARINES SUR	255	0 (0.0)	--	--	--	--
	CATANDUANES	202	0 (0.0)	--	--	--	--
	MASBATE	236	0 (0.0)	--	--	--	--
	SORSOGON*	429	17 (4.0)	2.5-6.3	14 (31.0)	3 (17.6)	0 (0.0)
	Total	1,517	17 (1.1)	0.7-1.8	14 (31.0)	3 (17.6)	0 (0.0)
6	AKLAN	316	0 (0.0)	--	--	--	--
	ANTIQUE	315	0 (0.0)	--	--	--	--
	CAPIZ	260	0 (0.0)	--	--	--	--
	GUIMARAS	283	0 (0.0)	--	--	--	--
	ILOILO	255	0 (0.0)	--	--	--	--
	NEGROS OCCIDENTAL*	619	2 (0.3)	0.1-1.3	1 (50.0)	1 (50.0)	0 (0.0)
	Total	2,048	2 (0.1)	0.0-0.4	1 (50.0)	1 (50.0)	0 (0.0)
8	BILIRAN	295	1 (0.3)	0.1-2.4	1 (100.0)	0 (0.0)	0 (0.0)
	EASTERN SAMAR*	506	1 (0.2)	0.0-1.4	1 (100.0)	0 (0.0)	0 (0.0)
	LEYTE*	443	2 (0.5)	0.1-1.8	0 (0.0)	1 (50.0)	1 (50.0)
	NORTHERN SAMAR*	589	59 (10.0)	7.8-12.7	47 (79.7)	12 (20.3)	0 (0.0)
	SOUTHERN LEYTE	264	0 (0.0)	--	--	--	--
	WESTERN SAMAR*	445	6 (1.4)	0.6-3.0	4 (66.7)	2 (33.3)	0 (0.0)
	Total	2,542	69 (2.7)	2.2-3.4	53 (77.0)	15 (21.7)	1 (1.4)
9	ZAMBOANGA DEL NORTE*	546	1 (0.2)	0.0-1.3	0 (0.0)	1 (100.0)	0 (0.0)
	ZAMBOANGA DEL SUR*	597	2 (0.3)	0.1-1.3	1 (50.0)	1 (50.0)	0 (0.0)
	ZAMBOANGA SIBUGAY*	481	6 (1.3)	0.6-2.8	5 (83.3)	1 (16.7)	0 (0.0)
	Total	1,624	9 (0.6)	0.3-1.1	6 (66.7)	3 (33.3)	0 (0.0)
10	BUKIDNON*	522	20 (3.8)	2.5-5.9	18 (90.0)	2 (10.0)	0 (0.0)
	CAMIGUIN	231	0 (0.0)	--	--	--	--
	LANAO DEL NORTE*	426	5 (1.2)	0.5-2.8	5 (100.0)	0 (0.0)	0 (0.0)
	MISAMIS OCCIDENTAL*	365	2 (0.6)	0.1-2.2	2 (100.0)	0 (0.0)	0 (0.0)
	MISAMIS ORIENTAL	265	0 (0.0)	--	--	--	--

Region	Province	No. of students examined	*S. japonicum* prevalence		Intensity of infection (%)		
			No. (%)	95% CI	Light	Moderate	Heavy
	Total	1,809	27 (1.5)	1.0-2.2	25 (93.0)	2 (7.0)	0 (0.0)
11	COMPOSTELA VALLEY*	550	0 (0.0)	--	--	--	--
	DAVAO DEL NORTE*	527	3 (0.6)	0.2-1.8	1 (33.3)	1 (33.3)	1 (33.3)
	DAVAO DEL SUR*	461	14 (3.0)	1.8-5.1	12 (85.7)	1 (7.1)	1 (7.1)
	DAVAO ORIENTAL*	541	2 (0.4)	0.1-1.5	2 (100.0)	0 (0.0)	0 (0.0)
	Total	2,079	19 (1.0)	0.6-1.4	15 (78.9)	2 (10.5)	2 (10.5)
12	NORTH COTABATO*	551	19 (3.5)	2.2-5.4	1 (5.3)	4 (21.1)	14 (73.7)
	SARANGANI	265	0 (0.0)	--	--	--	--
	SOUTH COTABATO*	558	2 (0.4)	0.1-1.4	2 (100.0)	0 (0.0)	0 (0.0)
	SULTAN KUDARAT*	508	5 (1.0)	0.4-2.4	4 (80.0)	1 (20.0)	0 (0.0)
	Total	1,882	26 (1.4)	1.0-2.0	7 (26.9)	5 (19.2)	14 (53.8)
CARAGA	AGUSAN DEL NORTE*	369	16 (4.3)	2.7-7.0	13 (81.3)	2 (12.5)	1 (6.3)
	AGUSAN DEL SUR*	216	7 (3.2)	1.5-6.7	5 (83.3)	0 (0.0)	1 (16.7)
	DINAGAT ISLANDS	224	1 (0.5)	0.1-3.1	1 (100.0)	0 (0.0)	0 (0.0)
	SURIGAO DEL NORTE*	337	5 (1.5)	0.6-3.5	3 (60.0)	2 (40.0)	0 (0.0)
	SURIGAO DEL SUR*	279	1 (0.4)	0.1-2.5	1 (100.0)	0 (0.0)	0 (0.0)
	Total	1,425	30 (2.1)	1.5-3.0	23 (79.3)	4 (13.8)	2 (6.9)
ARMM	BASILAN	240	1 (0.4)	0.1-2.9	0 (0.0)	1 (100.0)	0 (0.0)
	LANAO DEL SUR*	601	18 (3.0)	1.9-4.7	15 (83.3)	3 (16.7)	0 (0.0)
	TAWI-TAWI	197	1 (0.5)	0.1-3.6	0 (0.0)	1 (100.0)	0 (0.0)
	Total	1,038	20 (1.9)	1.3-3.0	15 (75.0)	5 (25.0)	0 (0.0)
Overall		**26,171**	**233 (0.9)**	**0.8-1.0**	**171 (73.7)**	**41 (17.7)**	**20 (8.6)**

*No *S. japonicum* parasite was detected among school children in the provinces of Regions 3, 4A, 7, NCR and CAR.